SYSTEM AND METHOD FOR PROCESSING LIQUID

FIELD OF THE INVENTION

The present invention generally relates to a device for processing liquid. More specifically, the invention is related to a device for directing the flow of liquid through a chamber such as, but not limited to, a filter.

BACKGROUND OF THE INVENTION

People often prefer water that has been purified prior to drinking. Even when cooking with water not entirely purified, people can notice an unsatisfying taste imparted into the food by the unpurified water used to cook the food. Although water is usually purified at local municipality water treatment plants, the purified water can still have unwanted additives resulting in an off or unsatisfying taste. The treatment process itself often imparts small amounts of chlorine or other chemicals that affect taste of the water. In addition, as water travels through community supply pipes and household plumbing, alien particles can enter a stream of water, thereby altering taste and reducing purity. In many rural areas wells are used to supply household water. Minerals found within the water table can affect the taste of water and leave stains on items cleaned with the well water. For these reasons, water filters have become commonplace in households.

FIG. 1 illustrates a typical connection of a filter **100** into a vertically running pipe. A vertical inlet pipe **102** provides a stream of liquid to a first T-fitting **104** that splits the liquid into a vertical stream and a horizontal stream. The vertical stream bypasses the filter **100** and proceeds on a vertical path exiting through an outlet pipe **106**. The

horizontal stream is directed to the filter **100** and passes through the filter **100** for processing. Once the liquid is filtered, the liquid is directed back to a second T-fitting **108,** where the horizontal stream re-enters the vertical stream before exiting through the outlet pipe **106**.

To control the flow of liquid through the filter **100,** a set of valves is installed. A first valve **110** is placed between the first T-fitting **104** and second T-fitting **108**. When the first valve **110** is open the stream is allowed to flow vertically to the outlet pipe **106** and bypass the filter **100**. By closing the first valve **110** the stream is prevented from bypassing the filter **100** and is directed horizontally at the first T-fitting **104** and through the filter **100**. A second valve **112** is placed between the first T-fitting **104** and the filter **100**. By closing the second valve **112** the flow of incoming liquid is prevented from flowing into the filter **100** during periods of maintenance to the filter **100**. A third valve **114** is placed between the filter **100** and the second T-fitting **108**. By closing the third valve **114** the flow of exiting liquid is prevented from flowing into the filter **100** during periods of maintenance. When the filter **100** is in operation the first valve **110** is closed and the second valve **112** and third valve **114** are opened. The liquid is prevented from bypassing the filter **100** by directing it horizontally into the filter **100** and then returning the flow back to the vertical pipe **102**. When the filter **100** is closed for repair or maintenance, the first valve **110** is opened and the second valve **112** and third valve **114** are closed. This allows the liquid to flow vertically, thereby bypassing the filter **100** and preventing the flow of liquid into the filter **100**.

The addition of a filter **100** to a vertical run pipe can become cost prohibitive. To add the filter **100** as shown in FIG. 1 a variety of components must be installed. These

components include two T-fittings, two elbows, three valves, and the necessary piping to connect the components. To install the filter, a portion of the vertical piping is removed. The two T-fittings and one of the valves are installed in place of the removed portion. The other two valves, two elbows, and filter are installed between the two T-fittings. Multiple sections of pipe are cut and soldered to individual components. This procedure often requires the skills of a professional plumber to install the components and filter. In addition, support brackets or other structures may be required to support the filter and additional plumbing components.

While filters **100** have been designed to connect onto a horizontally running section of pipe, many filters and other liquid processing devices cannot be used on spans of vertically running pipe. Some liquid processing chambers, by nature of their design, require that the processing chamber runs in a vertical direction. For example, a gravity filter may be required to run vertically to allow the sediment to settle at the bottom of the filter, or a chemical feeder may require the solids to settle at the bottom of the chamber, preventing too rapid of disbursement of the solid into the liquid stream. For these processing chambers, additional pipe may be required to provide a horizontal run of pipe to attach the filter. Issues such as space and accessibility of the processing chamber can often present problems in installation.

Thus, a heretofore unaddressed need exists in the industry to address the aforementioned deficiencies, inconveniences, and inadequacies.

SUMMARY OF THE INVENTION

Embodiments of the present invention provide systems and methods for

processing liquid. Briefly described, in architecture, one embodiment of the system, among others, can be implemented as follows.

The system contains a main body having a valve housing chamber with a main inlet port and a main outlet port along a non-horizontal axis, and a liquid inlet processing port and a liquid outlet processing port. The system also has a rotatable valve mounted within the valve housing chamber moving from a position that directs a flow of liquid from the main inlet port to the main outlet port to a position that directs a flow of liquid from the main inlet port to the inlet processing port and directs a flow from the outlet processing port to the main outlet port. In addition, the system has a processing chamber along a vertical axis, receiving a flow from the inlet processing port, processing the liquid, and directing the flow into the outlet processing port.

The present invention also provides a method of processing liquid, comprising the steps of: receiving a flow of liquid parallel with an axis aligned with gravity; directing the flow from a main inlet port to a main outlet port with the flow being parallel with the gravity axis and preventing the flow from entering an inlet processing port and an outlet processing port when a valve is in a first position; directing the flow from the main inlet port to the inlet processing port, directing the flow from the outlet processing port to the main outlet port, and preventing the flow from directly flowing from the main inlet port to the main outlet port when the valve is in a second position; and processing the flow comprising: receiving the flow from the inlet processing port, processing the flow along a vertical axis, and directing the flow into the outlet processing port when the valve is in the second position.

Other devices and advantages of the present invention will be or become apparent

to one with skill in the art upon examination of the following drawings and detailed description. It is intended that all such additional devices and advantages be included within this description, be within the scope of the present invention, and be protected by the accompanying claims.

The present liquid processing device allows the device to be connected to a vertical or vertically sloped pipe without the additional plumbing. The liquid processing device provides the additional benefits of not requiring additional plumbing or the increased complexity that would necessitate a professional plumber.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be more fully understood from the detailed description given below and from the accompanying drawing of the embodiments of the invention, which, however, should not be taken to limit the invention to the specific embodiments enumerated, but are for explanation and for better understanding only. Furthermore, the drawings are not necessarily to scale, emphasis instead being placed upon clearly illustrating the principles of the invention. Finally, like reference numerals in the figures designate corresponding parts throughout the several drawings.

FIG. 1 illustrates a typical water filter connected to a vertically running pipe.

FIG. 2 is a schematic diagram providing a top perspective view of a liquid processing device connected to an inlet pipe and an outlet pipe, in accordance with a first exemplary embodiment of the invention.

FIG. 3 is a schematic diagram providing a cross-sectional view of the liquid processing device of FIG. 2.

FIG. 4A is a schematic diagram providing a top perspective view of the main

housing of FIG. 3.

FIG. 4B is a schematic diagram providing a cross-sectional view of the main housing of FIG. 4A.

FIG. 5A is a schematic diagram providing a top perspective view of the valve of FIG. 3.

FIG. 5B is a schematic diagram providing a bottom perspective view of the valve of FIG. 5A.

FIG. 6A is a schematic diagram providing a cross-sectional view of the valve of FIG 5B.

FIG. 6B is a schematic diagram providing a bottom view of the valve of FIG. 6A.

FIG. 7A is a schematic diagram providing a cross-sectional view of the liquid processing device connected to the inlet pipe and outlet pipe with arrows depicting the flow of liquid in bypass mode.

FIG. 7B is a schematic diagram providing a cross-sectional view of the liquid processing device connected to the inlet pipe and outlet pipe with arrows depicting the flow of liquid in processing mode.

FIG. 8A is a schematic diagram providing a top perspective view of the liquid processing chamber stabilizer.

FIG. 8B is a schematic diagram providing a top profile of the liquid processing chamber stabilizer.

FIG. 8C is a schematic diagram providing a side profile of the liquid processing chamber stabilizer.

DETAILED DESCRIPTION

FIG. 2 is a schematic diagram providing a top perspective view of a liquid processing device **200** connected to an inlet pipe **102** and an outlet pipe **106**, in accordance with a first exemplary embodiment of the invention. The inlet pipe **102** and outlet pipe **106** connect to a main housing **202**. The inlet pipe **102** connects to a bottom of the main housing **202** at a main inlet port **203** and the outlet pipe **106** connects to the top of the main housing **202** at a main outlet port **205**. It should be understood that in different embodiments of the invention the direction of flow could be reversed, *i.e.*, the inlet pipe **102** could be connected to the top and the outlet pipe **106** can be connected to the bottom of the main housing **202**. A variety of connections can be used to connect the inlet pipe **102** and outlet pipe **106** to the main housing **202**, as would be understood by those having ordinary skill in the art. For example, the connections can be, but are not limited to, a compression fitting, a soldered connection, a hose clamp connection, or a quick release connection.

The main housing **202** has a valve housing chamber **406** (FIG. 4B) therein. A valve **302** (FIG. 3) controls the flow of liquid and is sited within the valve housing chamber **406** (FIG. 4B). Both the valve and valve housing chamber are described in greater detail below. A valve housing cover **204** secures the valve **302** (FIG. 3) in the valve housing chamber **406** (FIG. 4B). A portion of the valve **302** (FIG. 3) extends through a hole in the valve housing cover **204**. A lever **206** attaches to the portion of the valve **302** (FIG. 3). The valve housing cover **204** is fastened to the main housing **202** by screws, bolts, glue, or other fasteners that would be understood by those having ordinary skill in the art. Gaskets or other sealants (not shown) can be used to prevent the flow or

leaking of liquid around the valve housing cover **204**. The lever **206** is used to control the flow of liquid within the main housing **202**. When the lever **206** is parallel with the inlet pipe **102** and outlet pipe **106**, the flow is directed from the inlet pipe **102** directly to the outlet pipe **106**. When the lever **206** is rotated perpendicular to the inlet pipe **102** and outlet pipe **106**, the flow is directed into and out of an inlet processing channel **208** via the inlet processing port **207** and an outlet processing channel **210** via the outlet processing port **209**, respectively. The inlet processing channel **208** and outlet processing channel **210** direct the flow of liquid from the main housing **202** to and from the liquid processing chamber **212**. The liquid processing chamber **212** connects to the inlet **208** and outlet processing channels **210** via a processing chamber port **214**. The processing chamber port **214** supports the processing chamber **212** to the inlet **102** and outlet pipes **106**. The processing chamber **212** can also be secured to the inlet pipe **102** or outlet pipe **106** with a stabilizer **215**. The stabilizer **215** (described later in more detail) clamps around the inlet pipe **102** and provides support for the processing chamber **212**.

The liquid processing chamber **212** can perform a variety of different functions. In one embodiment, the liquid processing chamber **212** is a filter. It should be understood by one having ordinary skill in the art that the filter can comprise a variety of filters, for example but not limited to, gravity filters, osmosis filters, chemical filters, or ionizing filters. In addition, the liquid processing chamber **212** is not limited to filters. The liquid processing chamber **212** can comprise other liquid processing chambers, for example but not limited to, solid/liquid dispersing chambers, homogenizers, and samplers.

FIG. 3 is a schematic diagram providing a cross-sectional view of the liquid

processing device **200** of FIG. 2. Connectors are fastened to the inlet pipe **102** and outlet pipe **106** at the main inlet port **203** and main outlet port **205**, respectively. The connectors are screwed to the main housing **202**. Of course, the connectors may be connected to the main housing via different means. The valve **302** (discussed below in greater detail) directs the flow of liquid from the inlet pipe **102** to the outlet pipe **106**. The lever **206** is connected to a lever portion **304** of the valve **302** that extends behind the valve housing cover **204**. A screw **306,** or other fastening device, holds the lever **206** onto the valve **302**. The valve housing cover **204** is held into place by a fastening device, such as, but not limited to, a series of screws. By rotating the lever **206** so that a central axis of the lever **206** is perpendicular to a central axis of the inlet pipe **102**, the flow of liquid can be directed into the inlet processing channel **208** and out of the outlet processing channel **210**. The inlet processing channel **208** receives the stream of liquid and directs the liquid to a processing chamber inlet port **308** of the liquid processing chamber **212**. The outlet processing channel **210** receives the stream of liquid from a processing chamber outlet port **310** of the liquid processing chamber **212** and directs the liquid back to the main housing **202**. The valve **302** directs the flow of liquid into the outlet pipe **106** by preventing liquid from flowing back toward the inlet pipe **102**.

It should be noted that, in accordance with the first exemplary embodiment shown by FIG. 3, a filter **212** is utilized as the liquid processing chamber **212**. It should be noted, however, that other devices may be utilized as the liquid processing chamber **212**. The filter **212** mounts to the inlet processing channel **208** and the outlet processing channel **210** via the processing chamber port **214**. In this example, the filter **212** is attached via threads located on the processing chamber port **214**. The flow of liquid is

directed to the processing chamber inlet port **308** and down the walls of the filter **212**. The stream of liquid flows through filter material **314** and up the center of the filter **212**. The liquid returns to the main housing **202** through the processing chamber outlet port **310** and the outlet processing channel **210**.

FIG.4A is a schematic diagram providing a top perspective view of the main housing **202** of FIG. 3. In addition, FIG. 4B is a cross-sectional view of the main housing **202** of FIG. 4A. Referring to FIGS. 4A and 4B, the main housing **202**, inlet and outlet processing channels **208** and **210**, and processing chamber port **214** are shown not connected to the inlet pipe **102**, the outlet pipe **106**, or the liquid processing chamber **212**. Threads **400**, **402**, and **404** for connecting the inlet pipe, the outlet pipe, and the processing chamber, respectively, are displayed by FIG. 4B. The valve **302** (FIG. 3) fits within the valve housing chamber **406**. In one embodiment the main housing **202**, inlet and outlet channels **208** and **210**, and processing chamber port **214** are molded as a single unit. However, it should be understood by one having ordinary skill in the art that the individual components could be molded separately and later be permanently or removably fastened together by mechanical fasteners or glue. It should also be appreciated that these components can be manufactured from a variety of materials, for example but not limited to, plastics, metals, ceramics, or composites.

In accordance with the first exemplary embodiment of the invention, the inlet and outlet processing channels **208** and **210** are rotatably connected to the main housing **202**. This embodiment allows the liquid processing chamber **212** to hang vertically when the main housing **202** is connected to the inlet and outlet pipes **102, 106** that rise vertically. The amount of rotation of the inlet and outlet processing channels **208, 210** could be

adjusted based on the slope of the inlet and outlet pipes **102, 106**. In accordance with an alternative embodiment, the inlet and outlet pipes **102, 106** form a slope of 45 degrees; the inlet and outlet processing channels **208, 210** connect to the main housing **202** at a 45 degree angle allowing the liquid processing chamber **212** to hang perpendicular to the ground. The connection of the inlet and outlet processing channels **208, 210** to the main housing **202** can be accomplished by a bearing connection or can be screwed into place against a gasket. Of course, other connection means may be substituted.

Referring to FIGS. 5A and 5B, a top and bottom view of the valve **300**, respectively, is shown. The valve **300** has the lever portion **304** that extends beyond the valve housing cover **204** (FIG. 3) to connect to the lever **206** (FIG. 3). The lever portion **304** of the valve **302** can be shaped to allow the lever **206** (FIG. 3) to rotate the valve **302** without slipping. A screw hole **500** can be provided on top of the lever portion **304** to allow the lever **206** (FIG. 3) to be connected to the valve **302**. The valve **302** has a center channel **502** that allows the flow of liquid directly through the valve **302** when the ends of the center channel **502** are aligned with the inlet and outlet pipes **102, 106** (FIG. 3). Perpendicular to the center channel **502**, the valve **302** has a first elbow channel **504** and a second elbow channel **506**. The first elbow channel **504** receives the vertical flow from the inlet pipe **102** (FIG. 3) and directs the flow horizontally out the inlet processing channel **208** (FIG. 3). The second elbow **506** receives the horizontal flowing liquid from the outlet processing channel **210** (FIG. 3) and directs the flow vertically out the outlet pipe **106**.

When the valve **302** is rotated and the elbow channels **504** and **506** are aligned with the inlet and outlet pipes **102, 106** (FIG. 3), the flow of liquid is directed to the

liquid processing chamber **212** (FIG. 3) via the inlet and outlet processing channels **208, 210** (FIG. 3). A cover gasket **508** prevents leaking of liquid from the valve housing cover **204**. Two small gaskets **510** on the bottom of the valve **302** prevent leaking from the inlet and outlet processing channels **208, 210** (FIG. 3) when the valve **302** is positioned to bypass the liquid processing chamber **212** (FIG. 3).

FIG. 6A is a schematic diagram providing a cross-sectional view of the valve **302** of FIG. 5A. The center channel **502** is shown aligned with the direction of view (FIG. 6A). Walls of the first and second elbows **504** and **506** are shown on the bottom periphery of the valve **302**.

FIG. 6B is a schematic diagram providing a bottom view of the valve of FIG. 5A. A valve guide **600** located on the bottom of the valve **302** holds the valve 302 in the center of the valve housing chamber **406** (FIG. 4B), while allowing the valve 302 to rotate within the valve housing chamber **406** (FIG. 4B). The two elbows **504** and **506** are shown along with the two gaskets **510** that prevent leaking when the valve **302** is positioned to by-pass the liquid processing chamber **212** (FIG. 3).

FIG. 7A is a schematic diagram illustrating liquid flow via use of the liquid processing device **200**, when the lever **206** is vertical. Referring to FIG. 7A, the lever **206** is aligned in the vertical direction allowing the liquid to bypass the filter **212**. The liquid flows from the inlet pipe **102** into the main housing **202** and through the valve **302**, via the center channel **502**. The liquid exits the valve **302** through the center channel **502** and enters the outlet pipe **106**. The valve **302** prevents the flow of liquid into and out of the inlet and outlet processing channels **208, 210**.

FIG. 7B is a schematic diagram illustrating liquid flow via use of the liquid

processing device **200**, when the lever **206** is horizontal. Referring to FIG. 7B, the lever **206** is aligned perpendicular to a central axis of the inlet and outlet pipes **102**, **106**. The liquid flows from the inlet pipe **102** into the main housing **202**, and into the valve **302**. The first elbow channel **504** (FIG. 5B) of the valve **302** directs the liquid from a vertical direction to a horizontal direction, out of the main housing **202** into the inlet processing channel **208**. The inlet processing channel **208** directs the liquid horizontally and directs it in a direction vertically parallel with the inlet and outlet pipes **102**, **106** into the processing chamber inlet port **308**. The liquid flows down around the perimeter walls of the filter **212**. The liquid passes through the filter material **314** (FIG. 3) toward the center of the filter **212** and then up through the processing chamber outlet port **310**. The outlet processing channel **210** receives the liquid flowing in a vertical direction and directs the flow horizontally into the main housing **202**. The second elbow **506** (FIG. 5B) of the valve **302** directs the horizontal flow into a vertical flow and out the main housing **202**. The liquid then enters the outlet pipe **106**.

FIGS. 8A, 8B, and 8C are schematic diagrams providing different views of the liquid processing chamber stabilizer **215** of FIG. 2. Referring to FIGS. 8A, 8B, and 8C, the liquid processing chamber stabilizer **215** comprises a clamp portion **800** and two arms **802**. The clamp portion **800** wraps around the inlet pipe **102** (FIG. 3). The two arms **802** extend around sides of the liquid processing chamber **212** (FIG. 3) providing horizontal support. A fastener may be placed through a fastener hole **804** to secure the clamp portion 800 around the inlet pipe **102** (FIG. 3). In one embodiment, a screw positioned between the inlet pipe **102** (FIG. 3) and the liquid processing chamber **212** (FIG. 3) is used to secure the clamp portion **800** around the inlet pipe **102** (FIG. 3). It should be

appreciated by one having ordinary skill in the art that the stabilizer **215** can be manufactured using a variety of materials. Examples of material used may be, but are not limited to, plastics, metals, or composites.

In another embodiment (not shown) the arms **802** extend and wrap around the liquid processing chamber **212** (FIG. 3). A fastener located between the inlet pipe **102** (FIG. 3) and the liquid processing chamber **212** (FIG. 3) secures the arms. The fastener secures the stabilizer **215** around both the inlet pipe **102** (FIG. 3) and the liquid processing chamber **212** (FIG.3). In this embodiment the stabilizer **215** provides greater support to the liquid processing chamber **212** (FIG. 3). The stabilizer **215** prevents the liquid processing chamber **212** (FIG. 3) from rocking in a horizontal direction and wraps tightly around the liquid processing chamber **212** (FIG. 3) preventing the chamber **212** (FIG. 3) from sliding in a vertical direction.

It should be emphasized that the above-described embodiments of the present invention are merely possible examples of implementations, merely set forth for a clear understanding of the principles of the invention. Many variations and modifications may be made to the above-described embodiment(s) of the invention without departing substantially from the spirit and principles of the invention. All such modifications and variations are intended to be included herein within the scope of this disclosure and the present invention and protected by the following claims.